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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/577,374	01/23/2007	David M. Sutton	KPT 1101	6215
321 7590 04/29/2009 SENNIGER POWERS LLP 100 NORTH BROADWAY 17TH FLOOR ST LOUIS, MO 63102				
EXAMINER VALENROD, YEVGENY				
ART UNIT		PAPER NUMBER		
1621				
NOTIFICATION DATE		DELIVERY MODE		
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspatents@senniger.com

Office Action Summary

Application No.

10/577,374

Applicant(s)

SUTTON ET AL.

Examiner

YEVEGENY VALENROD

Art Unit

1621

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 November 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3,5-7 and 9-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3,5-7 and 9-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/S508)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/21/08 has been entered.

Remarks and amendments filed 11/21/08 have been fully considered. Remarks are addressed following the text of the maintained rejections.

New Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-3, 5, 6, 9, 10, 11, 12, 13, 14, 15 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mims (US 4,058,555).

Scope of prior art

Mims teaches a process where a stream comprising succinic acid in water is concentrated (column 9, line 65), fed to a reactor where it is heated to 57degC then a

second reactor where it is heated to 98degC (column 10, lines10-16). The product is then treated methanol at 50degC to produce dimethyl ester of succinic acid. (column 10 lines 30-55). The product is then extracted and water is separated under reduced pressure (column 10 lines 60-64).

Ascertaining the difference

The difference between instant claims and prior art is the temperature at which esterification is performed.

Also, Mims fails to teach the placement of the heaters on the reactor.

Obviousness

Altering temperature and pressure to determine optimal reaction condition is common practice in the art and one skilled in the art would find it obvious to do so as part of routine optimization.

It is obvious to place a heater at any position of the reactor. Placement of the heater is obvious absent unexpected results.

Maintained Claim Rejections - 35 USC § 103

A) Rejection over Cooley et al.

Claims 1- 3, 5, 10-12, and 16-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cooley et al. (US 4,032,458) in view of Turner et al (US 4,751,334) and in further view of Mims (US 4,058,555)

Scope of prior art

Cooley et al. disclose a continuous process for production of 1,4-butanediol by supplying maleic acid containing 56.45% water(Column 13, Example 1, lines 63-65) to an esterification zone comprising n-butanol where the butyl ester of maleic acid is produced. Cooley et al describe bringing the reaction mixture to reflux (column 13 line 61), which means that the mixture was heated. In order to advance this reversible reaction, water needs to be removed. Cooley et al. accomplish removal of water via distillation of water-butanol azeotrope (column 11, line 20-23, and Figure on the title page showing esterification/dehydration chamber 10 and stream 15). The produced ester is subjected to catalytic hydrogenation (column 11, line 61-column 12, line 6).

Ascertaining the difference

Cooley et al fail to teach:

- a) Recycling of water to step (a) (claim 3).
- b) Position of the heater for the esterification process (claim 11).
- c) Vapor phase hydrogenation (claim 18).
- d) Recycling of butanol recovered in the hydrogenation (claim 19).
- e) Cooley et al. fail to present an example where methanol is utilized in the described process.

Secondary reference

Turner et al. teach vapor phase hydrogenolysis of maleic acid esters to produce 1,4-butadiene.

Mims teaches treatment of dicarboxylic acids such as succinic acid with methanol in the presence of water to produce a dimethyl ester (column 10, lines 21-30).

Obviousness

Recycling of water:

One of ordinary skill in the art would be motivated to recycle water recovered from the esterification process into the esterification reactor. Doing so reduces the amount of water required for the process and has economic and environmental benefits. Applicant has not indicated any unexpected results arising from using water recovered in the process when compared to using water obtained elsewhere. Recycling of water to any part of the reactor that requires water is therefore obvious absent unexpected results.

Position of the heater in the esterification process:

One of ordinary skill in the art would be motivated to position the heater at any place on the esterification reactor where the heater will perform its designed function which is to heat the solution in the reactor. Since the process of Cooley et al. requires a distillation column for azeotropic removal of water-butanol, it is logical to place the heater on the bottom of the reactor where, which is where the reagents are introduced. Applicant has not provided unexpected results that arise as a result of specific heater position. Absent such results, limitation of claim 11 is obvious in view of Cooley et al.

Vapor phase hydrogenation:

Turner et al teach vapor phase hydrogenation and hydrogenolysis of diethyl malonate to produce butane 1-,4-diol (column 1, lines 11-16). They teach that their process provides a method of producing 1,4-butane-diol from the starting materials that are obtained from butane or benzene feedstock through maleic anhydride. In view

Cooley et al and Turner et al applicants' invention is obvious. There is no unexpected result from using vapor phase hydrogenation. In fact Turner et al. describe their process as designed for the very purpose in which applicant uses it. Combining two methodologies where each one serves its intended purpose is obvious absent unexpected results.

In column 6, line 65 - column 7, line 6, Cooley et al teach that the butanol used in the esterification need not be removed prior to hydrogenation of the esters. In hydrogenation butanol can serve as a solvent (although it is not necessary) and disperse heat that is generated by the exothermic hydrogenation process. One of ordinary skill in the art would find it obvious to recover the solvent after the hydrogenation process and reuse it in the esterification reaction. Motivation for recovery of butanol comes from environmental and economic concerns. Recovery of butanol is therefore obvious absent unexpected results.

Methanol as the monohydric alcohol:

Although Cooley et al do not exemplify methanol as a monohydric alcohol they do not exclude it from their invention. In column 2, lines 44-57 Cooley describe monohydric alcohol suitable in their invention **include** those having from 2 to 10 carbon atoms, however the language is not limiting and one skilled in the art would find it obvious to use any monohydric alcohol including methanol. In addition Mims teaches that treatment of aqueous diacids with methanol produces diacids, which provides one skilled in the art with expectation of success. Mims demonstrates that treatment of aqueous solution comprising succinic acid results in dimethyl succinate. Since succinic

acid is a 4-carbon carboxylic acid one skilled in the art would expect that when aqueous solution of maleic acid is treated with methanol, diesterification will take place.

Reply to applicants' remarks on Cooley

On page 7 of the remarks applicants have argued that the text of Cooley et al. states that suitable monohydric alcohol has from 2 to about 10 carbon atoms and therefore does not include methanol. Applicants have also argued that additional evidence for exclusion of methanol is where Cooley et al state that preferred alcohols for the process are those capable of forming an azeotrope with water. Examiner respectfully disagrees.

In column 2, lines 46-49: "The monohydric alcohols which are suitable in the practice of the process of this invention include monohydric alcohols having from 2 to about 10 carbon atoms." The language used does not exclude methanol because the definition is not limiting. The term "include" in line 47 opens the definition to include monohydric alcohols that are not 2-10 carbons.

Although Examiner agrees that methanol is not a preferred alcohol in Cooley's process, one skilled in the arts would still expect use of methanol to result in production of methyl ester. Adding methanol to a solution of carboxylic acid and water and heating the said solution will invariably result in formation of equilibrium between carboxylic acid and ester. There is reasonable expectation that the diester will be formed. The

reasonable expectation of success comes from the teaching of Mims where aqueous succinic acid is treated with methanol to produce a diester.

Concerning arguments directed to the pressure and temperature at which the esterification is carried out (page 8, lines 1-21 of the remarks). Applicants have pointed out that the necessary operating pressure for the reactor in Cooley depends on the alcohol. While the described trend for the preferred alcohols is higher pressure with lighter alcohol, the broader teaching is that altering pressure is necessary to find optimal conditions. When using methanol, one skilled in the art would find it obvious to determine an optimal pressure for the process. Applicants have also argued that the overlapping pressure ranges in the instant claims and in Cooley are not sufficient to render the claimed pressure obvious (page 10 of Remarks). Examiner again disagrees with the applicants. Applicants compare the example using butanol as the monohydric alcohol with the instant claims. While using butanol, required pressure range that overlaps the instantly claimed range (3.8 - 5.5 bar in Cooley compared to 1 - 5 bar in the claims). This comparison is not what the obviousness argument for the limitation directed to pressure is based on. Cooley teaches that pressures are different for different alcohols. One skilled in the art would therefore find it obvious to alter the pressure of the reaction where methanol is the monohydric alcohol in order to optimize the reaction parameters, irrespective of what the preferred range for butanol is.

Finally, Turner et al is only utilized in the above rejection to teach vapor phase hydrogenolysis of maleic acid esters. It is not meant to cure the deficiencies directed to the pressure and the nature of the alcohol in the esterification reaction.

B) Rejection over Schwartz et al.

Claims 1, 2, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schwartz et al. (GB 1,437,898) in view of Cockrem et al. (US 5,210,296) and Mims et al (4,058,555).

Scope of prior art

Schwartz et al teach a continuous 2-stage process for preparation of a diester of maleic acid. The first stage comprises production of monoesters which are subsequently converted to diesters in the second stage (Example 1 on page 4). The maleic acid for the process is obtained via scrubbing of maleic anhydride with water (page 1, lines 40-50). Water content in the feed is above 50% (page 4, column 1, lines 33-37). Water and alcohol are removed from the esterification zone by azeotropic distillation (page 4, lines 4-7) and esterification zone is heated with an aid of a heater (page 4, lines 89-90).

Ascertaining the difference

Schwartz et al fail to teach:

- a) Recycling of water to the maleic anhydride scrubbing process (claim 22).
- b) Use of catalyst in the second step of the process (claim 14).
- c) Schwartz et al. fail to provide an example where methanol is used as a monohydric alcohol.

Secondary references

Cockrem et al teach a method for producing high purity lactate ester by supplying concentrated fermentation broth, adding butanol and sulfuric acid (liquid acid catalyst), heating the reaction to while removing water as an azeotrope with butanol and recovering the ester product (see columns 11-12, Example 1).

Mims teaches treatment of dicarboxylic acids such as succinic acid with methanol in the presence of water to produce a dimethyl ester (column 10, lines 21-30).

Obviousness

Recycling of water to the maleic anhydride scrubbing process:

Schwartz et al teach that maleic acid used in their invention is produced via scrubbing maleic anhydride with water in order to produce a crude aqueous solution of maleic acid (page 1, lines 45-50). One of ordinary skill in the art would find it obvious to recycle water that is recovered from production of diesters in order to utilize it in the production maleic acid. Doing so reduces the amount of water required for the process and is therefore more economical and environmentally friendly. Recycling of reagents is common in the art and is therefore obvious absent unexpected results.

Use of catalyst in the second step of the esterification process:

Cockrem et al. teach use of catalyst in esterification process. Catalysts are well known to lower the activation energy of the process and thereby increase production rate. One practicing the process of Schwartz et al. would find it obvious to use a catalyst in first or/and second step of esterification. Although the process of Cockrem et al. utilize a starting material that is different from Schwartz et al., functional group interconversion is the same, acid to an ester. Because the functional group

interconversion is the same one skilled in the art would expect utilization of Cockrems' catalyst in the process of Schwartz et al to be successful.

Cockrem et al. also teach concentrating the starting material prior to esterification step (see fig 1 and fig 2). Water is well known to be a reagent in ester hydrolysis and it is common to minimize water in the esterification reaction in order to push the reaction equilibrium to the ester product. One skilled in the art would be motivated to concentrate a mixture of carboxylic acid and water prior to performing the esterification step in order to reduce the reaction duration and amount of alcohol required. Cockrem et al. demonstrate the utility of such a step.

Schwartz et al. exemplify n-butanol and n-hexanol as the monohydric alcohol. However their invention is not limited to the 4 and 6 carbon alcohols, alcohols that may be employed include 1 carbon alcohols, which includes methanol. One skilled in the art would find it obvious to select any alcohol that is described by Schwartz et al. as capable of being used in their invention. Further expectation of success in using methanol is provided by Mims. Mims demonstrates reaction of aqueous succinic acid with methanol to produce dimethyl succinate.

Reply to applicants remarks on Schwartz

Applicants argued that the Schwartz reference cannot be considered alone but must viewed together with teachings of Cooley et al. Applicants have argued that Cooley excludes methanol from the list of monohydric alcohols to be used in the esterification process. Examiner respectfully disagrees. Examiner believes that neither

Schwartz not Cooley exclude methanol. Methanol is not the preferred alcohol, but it is not excluded. Schwartz clearly teaches 1-carbon alcohols for the process (although an example is not provided) and Cooley does not limit the scope of alcohols to those 2-carbons or more. Only the preferred alcohols are 2-carbons or more in Cooley.

Applicants have also argued that when the sum of the teaching of Cooley and Schwartz are considered, one would not expect the esterification reaction to work for methanol at all. Examiner disagrees. When the processes are considered as a whole, one would expect the the esterification with methanol to work. Methanol is not the preferred alcohol, so one might not expect the result to be as high-yielding as for other alcohols, but one would certainly expect that when a carboxylic acid is heated in the presence of methanol some of the acid will be converted to ester.

Conclusion

Claims 1-3, 5-7 and 9-22 are pending

Claims 1-3, 5-7 and 9-22 are rejected

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Yevgeny Valenrod whose telephone number is 571-272-9049. The examiner can normally be reached on 8:30am-5:00pm M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Daniel Sullivan can be reached on 571-272-0779. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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